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SAFAR-INDIA (Pune)

SAFAR-HIGH RESOLUTION GRIDDED EMISSIONS INVENTORY OF PUNE, PIMPRI AND CHINCHWAD REGIONS

- Accounting 26 Local Sources of Emission

Indian Institute of Tropical Meteorology, Pune

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SAFAR-HIGH RESOLUTION GRIDDED EMISSIONS INVENTORY OF PUNE, PIMPRI AND CHINCHWAD REGIONS

System of Air Quality and Weather Forecasting And Research (SAFAR) - PUNE

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EXECUTIVE SUMMARY

SAFAR-HIGH-RESOLUTION (400m x 400m) GRIDDED EMISSIONS INVENTORY FOR PUNE, PIMPRI AND CHINCHWAD REGIONS

Air pollution research is increasingly becoming a topic of immediate interest due to its close linkages with Human health and ecosystem. Unlike several other irreversible processes, anthropogenic sources (human-made) can be inverted as a major cause of air quality deterioration. When the local concentrations of air pollutants exceed a specific threshold limit, it can harm the health of human beings, plants and animals. Most of the mega-cities worldwide are experiencing the deterioration of air quality. The various natural and anthropogenic sources account for environmental pollutant emissions load. The anthropogenic emission is on the rise. Emission Inventory is a comprehensive listing by local sources of air pollutant emissions and the number of air pollutants released into the air due to a specific process in a particular geographic region during a specific period. It is one of the most critical factors required for air pollution forecasting models and meteorological input to forecast the air quality and frame the mitigation strategy. Quality of forecasting depends on the accuracy and reliability of emission estimation. Emission inventories could also be used for air quality management and formulating environmental policy.

Emission inventory development is an area of current interest but a complex process due to numerous, diverse and widely dispersed emission sources in Pune region. Region covers multiple megapolis like Pune, Pimpri and Chinchwad (includes PMC, PCMC, KCB, PCB, DCB & adjoining region), called as “Pune Metropolitan Region (PMR)” in the rest of this report. The widespread campaign requires a vast amount of ultra-high-resolution activity data, emission factors, and knowledge of fundamental scientific processes. An extensive scientific field campaign has been carried out in PMR by involving more than 200 student volunteers from different colleges along with SPPU for several months jointly organized by IITM and SPPU. An orientation workshop has been arranged for the volunteers. Total campaign covered ~250,000 hours of data collection. The campaign's main focus was to generate missing primary data, validate some uncertain secondary data, and collect the available secondary data. The final product delivered was a high resolution (400m x 400m grid) gridded emission inventory of eight crucial air pollutants ($PM_{2.5}$, PM_{10}, NOx, CO, SO_2, BC, OC, VOCs as NMVOCs). Emissions inventory is developed for the PMR-region of 50km x 50km. During the campaign, following activity data and relevant information related to major /

minor sources from 26 different targets have been collected as part of an elaborate exercise in a mission mode.

PMR is rapidly growing region of India, experiencing remarkably high vehicular density. The traffic volume has been calculated using click counters on different major and minor roads of the study area. The current campaign has covered more than 200 primary and minor roads from Municipal Corporation limits and fringe areas.

To develop the emission inventory, a bottom-up approach has been adopted. The Geographical Information System (GIS) based statistical model developed by SAFAR earlier has been used to prepare high-resolution gridded emission inventory. The emissions of PM_{10} and $PM_{2.5}$ from various sources along with relative % share of various sources are given in **Table-a**. Current emission estimates (Gg/Yr) in the PMR region for different pollutants, namely, BC, OC, NOx, CO, SO_2, and VOCs for the year 2019-20 are given in **Table-b.**

Table-a: Absolute Emission (Gg/yr) and Relative sectoral share of $PM_{2.5}$ & PM_{10} Emissions for Yr 2019-20

	$PM_{2.5}$		PM_{10}	
Sources	Emissions (Gg/Yr)	Sectoral Share	Emissions (Gg/Yr)	Sectoral Share
Transport	21.2	45.6%	21.8	25.2%
Industrial	11.3	24.4%	20.6	23.8%
Residential*	06.0	12.9%	10.8	12.4%
WBR Dust	02.9	06.2%	27.2	31.4%
Other#	05.0	10.8%	06.2	07.2%
Total	**46.4**	**----**	**86.6**	**----**

** **Residential Sector -** Residential cooking, Slum, Trash. Burning, Cow Dung, Street Vendor, Household, Wood burning, etc. **# Other Sector -** MSW Plants, MSW Open Burning, Crematory, Aviation, Incense Stick, Brick Clams, etc. WBR Dust- Wind Blown Re-suspended Dust*

Table-b: Absolute Emission in Gg/Yr of Different Pollutant Emissions from Different sectors Yr 2019-20

Sector (Gg)	BC	OC	NOx	CO	SO_2	VOCs
Transport	3.18	4.93	162.69	194.05	30.27	146.82
Industry	2.31	4.76	45.21	5.03	157.72	26.29
Residential*	1.33	2.708	6.94	65.67	1.97	16.125
Other#	0.65	3.10	7.17	28.10	1.61	1.20
	7.47	**15.50**	**222.01**	**292.85**	**191.57**	**190.44**

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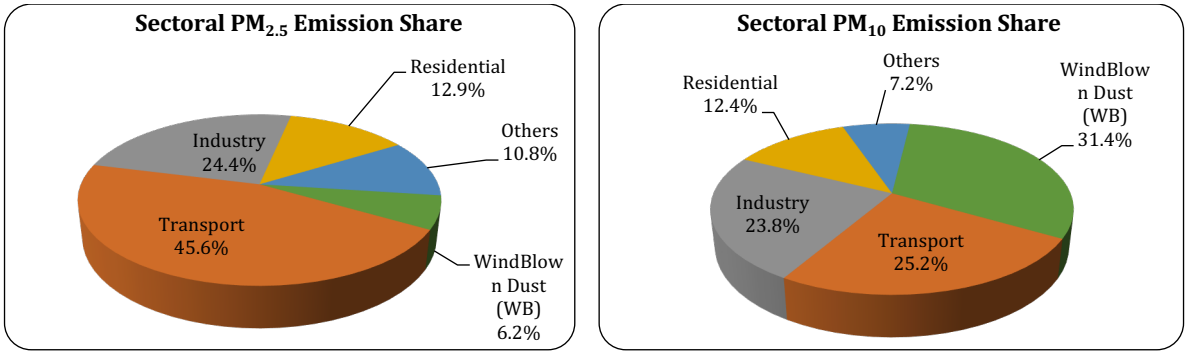

Figure-a: Relative Contribution of $PM_{2.5}$ & PM_{10} Emissions

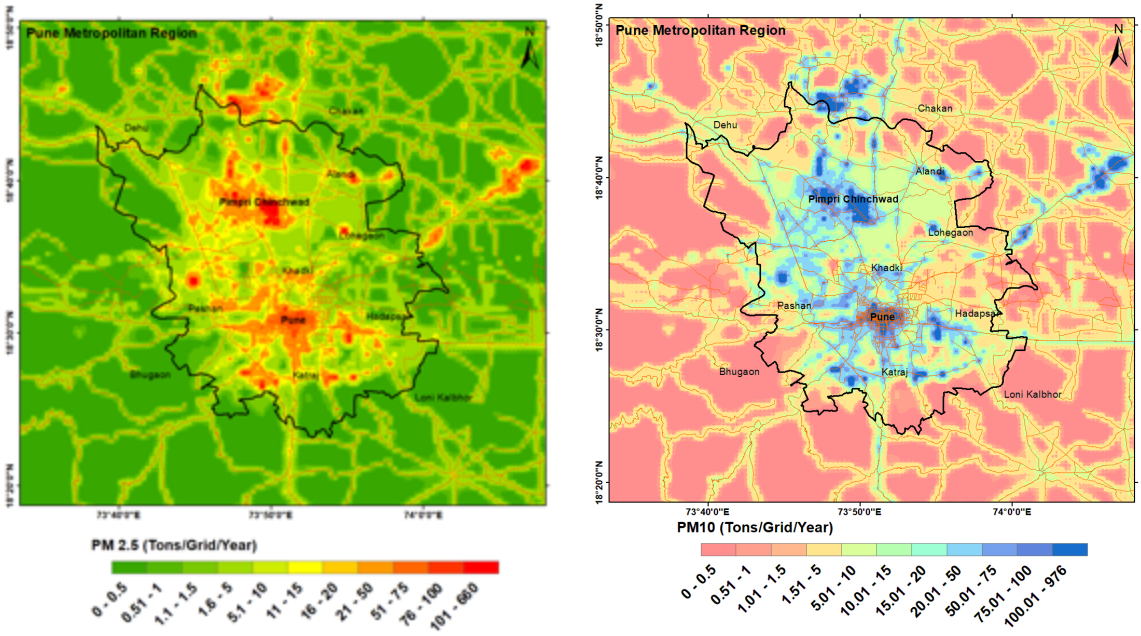

Figure-b: Geographical distribution of $PM_{2.5}$ & PM_{10} Emissions

Sectoral share illustrates – transport and vehicular movement induced re-suspended dust accounted for >50% of the particulate load (**Figure-a**). Residential and industrial contribute identical for PM_{10} and $PM_{2.5}$. Particulate concentration have spatially distributed all over the PMR region (**Figure-b**). Densely populated central areas have accounted for higher emissions. The transport being prominent source, found to be spread all across the study region. Northern areas are characterized with an industrial cluster along with associated residences and eateries. Some green cover i.e. hills, cantonment, university, gardens – spread across the region curtails the pollution at some extent. Out of city limits, predominantly Eastern and northern part have major state highways with heavy traffic.

Emissions Growth from 2012-13 to 2019-20: The percentage growth of emissions of various pollutants during seven year period has been estimated which is found to be highly significant. The % growth in 2019-20 as compared to 2012-13 is found to be 81.3% for OC, 72.8% for NOx, 69.8% for VOCs), and 30.2% for SO_2. (**Table-c**) The overall increase in the emissions of PM_{10} and

$PM_{2.5}$ over PMR region, which includes Pune, Pimpri and Chinchwad region, from 2012-13 to 2019-20 is found to be 61% and 70% respectively. Pune is a mix of land use province, ranging from commercial, residential, agricultural, reserved forests and water bodies. Given the extensive reforms in an industrial sector, it managed to control the emissions leading to moderate growth. Vehicles remain the major contributor of $PM_{2.5}$ emissions, followed by industries.

Table-c: Percent Change in PM_{10} & $PM_{2.5}$ Emissions during Past 7yrs (Yr2012-13 to Yr2019-20)

SECTORS	PM_{10}	$PM_{2.5}$
Transport	↑ 87.9%	↑ 91.0%
Industrial	↑ 33.8%	↑ 32.9%
Residential*	↑ 107.7%	↑ 57.9%
WBR Dust	↑ 49.5%	↑ 38.1%
Other#	NA$	NA$
Total	**↑ 61.3%**	**↑ 70.0%**

** **Residential Sector -** Residential cooking, Slum, Trash. Burning, Cow Dung, Street Vendor, Household, Wood burning, etc. **# Other Sector -** MSW Plants, MSW Open Burning, Crematory, Aviation, Incense Stick, Brick Clams, etc. WBR Dust- Wind Blown Re-suspended Dust **$** Many sources newly added so not appropriate to show growth.*

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